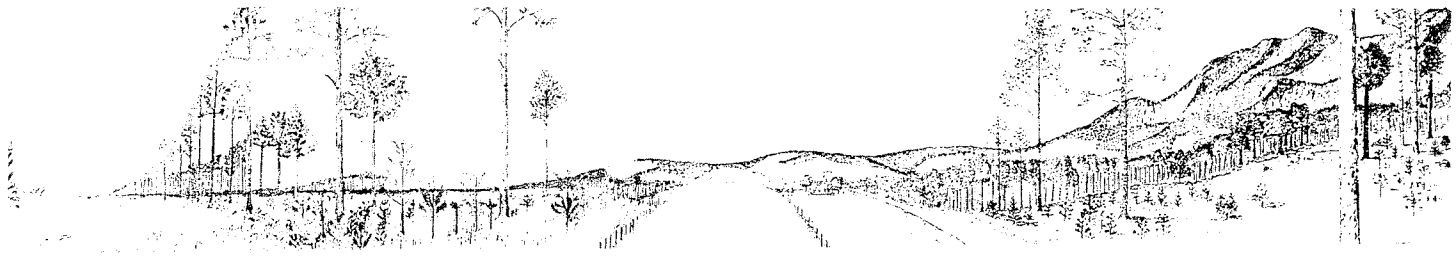

USDA Forest Service Research Note SE-135 August 1970

DISTRIBUTION OF REDWOOD CAUSED BY THE BALSAM WOOLLY APHID IN FRASER FIR OF NORTH CAROLINA

Abstract.--Examination of 5-foot sections of felled Fraser fir, Abies fraseri (Pursh) Poir., trees infested or killed by the balsam woolly aphid, Adelges piceae (Ratzeburg), revealed that the height of the first annual ring of aphid-caused redwood increased as the height of the trees increased. The number of red rings varied from two in a tree 5 inches in d.b.h. to five or six in all trees 9 or more inches in d.b.h., indicating that larger trees can sustain aphid attacks for longer periods before death than can smaller trees.

INTRODUCTION

Fir trees die when the balsam woolly aphid, Adelges piceae (Ratzeburg) (Homoptera: Phylloxeridae), introduces a growth-stimulating substance into the bark.[1] This substance stimulates cells in the bark to enlarge and develop thick walls. In addition, the cambium is stimulated to produce an enlarged xylem ring, the cells of which have thick, brittle, reddish walls. This abnormal redwood interferes with conduction. Researchers[1 2] have suggested that water stress, the consequence of reduced lumen area in the cells of the affected wood, may be the ultimate cause of tree death.

The first appearance of redwood indicates the height at which the aphid first attacks the tree and discloses that portion of the trunk which should be examined for early detection of the white waxy secretions of the aphid, usually the first sign of infestation. The number of red annual rings is an indicator of the number of years of aphid infestation that a tree of a given size can sustain before dying. This note presents data on (1) the height of initial aphid attack on Fraser fir, Abies fraseri (Pursh) Poir., trees of different sizes and (2) the number of years of aphid attack that Fraser firs sustain before death.

[1] Balch, R. E. Studies of the balsam woolly aphid, Adelges piceae (Ratz.), and its effects on balsam fir, Abies balsamea (L.) Mill. Can. Dep. Agr. Pub. 867, 76 pp. 1952.

[2] Mitchell, R. G. Translocation of dye in grand and subalpine firs infested by the balsam woolly aphid. Pacific Northwest Forest & Range Exp. Sta., U. S. Forest Serv. Res. Note PNW-46, 17 pp. 1967.

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METHODS

Twelve living Fraser firs infested by the balsam woolly aphid and 15 Fraser firs killed by the aphid were felled near Mt. Mitchell and Roan Mountain, North Carolina, in 1964. These trees ranged from 5 to 23 inches in d.b.h. and from 20 to 85 feet in height, were all over 25 years old, and were growing in closed stands. The stems were cut into 5-foot sections, and the ends of these were examined for redwood caused by the aphid. Records were taken of the number of red annual growth rings found at each height and of the years when they were formed.

RESULTS AND DISCUSSION

The distribution of redwood indicated that the height of the first red annual ring increased as the height of the trees increased ($r = 0.82$). The occurrence of the first red ring varied from 5 feet in a tree 20 feet tall to 70 feet in a tree 85 feet tall (fig. 1). The location of the initial attack is probably related to behavior of the aphid crawler, which has been observed to concentrate in diffuse light of moderate intensity.[3]

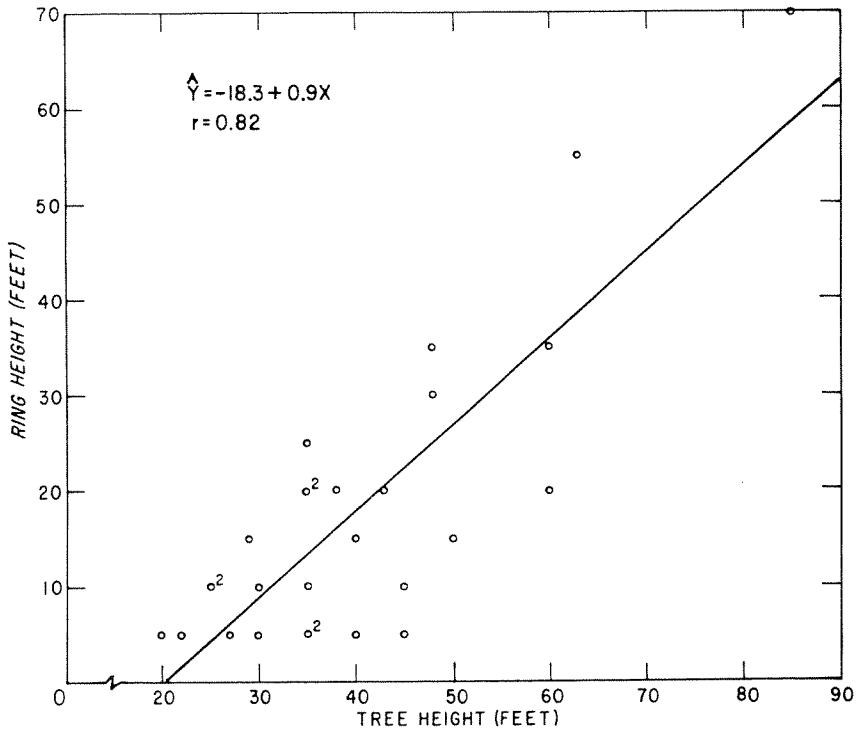

Figure 1.--Height of first growth ring discolored by the balsam woolly aphid on Fraser firs having different heights.

[3] See footnote 1.

The height of the first red ring was also related to d.b.h. of the tree (fig. 2). This relationship was not as strong (r = 0.73) as the relation to total height of the tree, however, and would be a less reliable indicator of the height at which the aphid might be expected to make its first attack. The multiple regression with both d.b.h. and tree height resulted in a correlation coefficient of 0.83, which was only slightly higher than the coefficient of 0.82 for tree height alone.

Trees with small diameters were killed quicker by aphid infestation than were trees with large diameters. The number of red rings varied from two in a tree 5 inches in d.b.h. to six in a tree 19 inches in d.b.h. (fig. 3). However, all trees 9 inches or more in d.b.h. had about the same number of red rings (five or six) before death. While this may be the maximum number of years of infestation that Fraser fir trees can sustain in closed stands, trees in less dense stands have supported aphid populations for up to 7 years (Unpublished data, author's files).

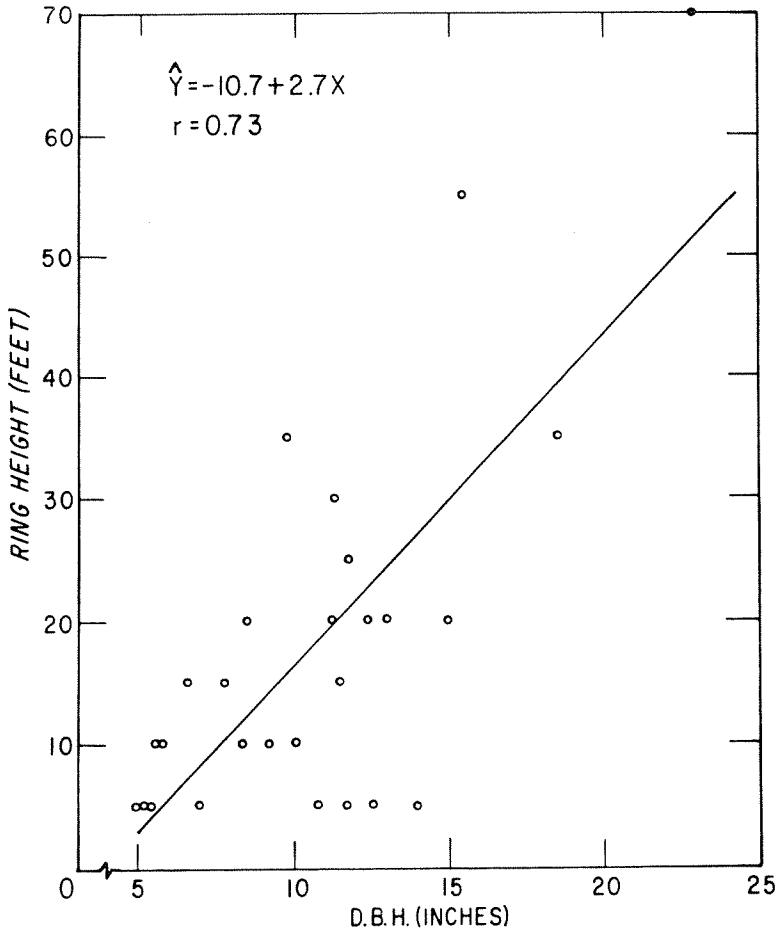

Figure 2.--Height of first growth ring discolored by the balsam woolly aphid on Fraser firs having different diameters at breast height.

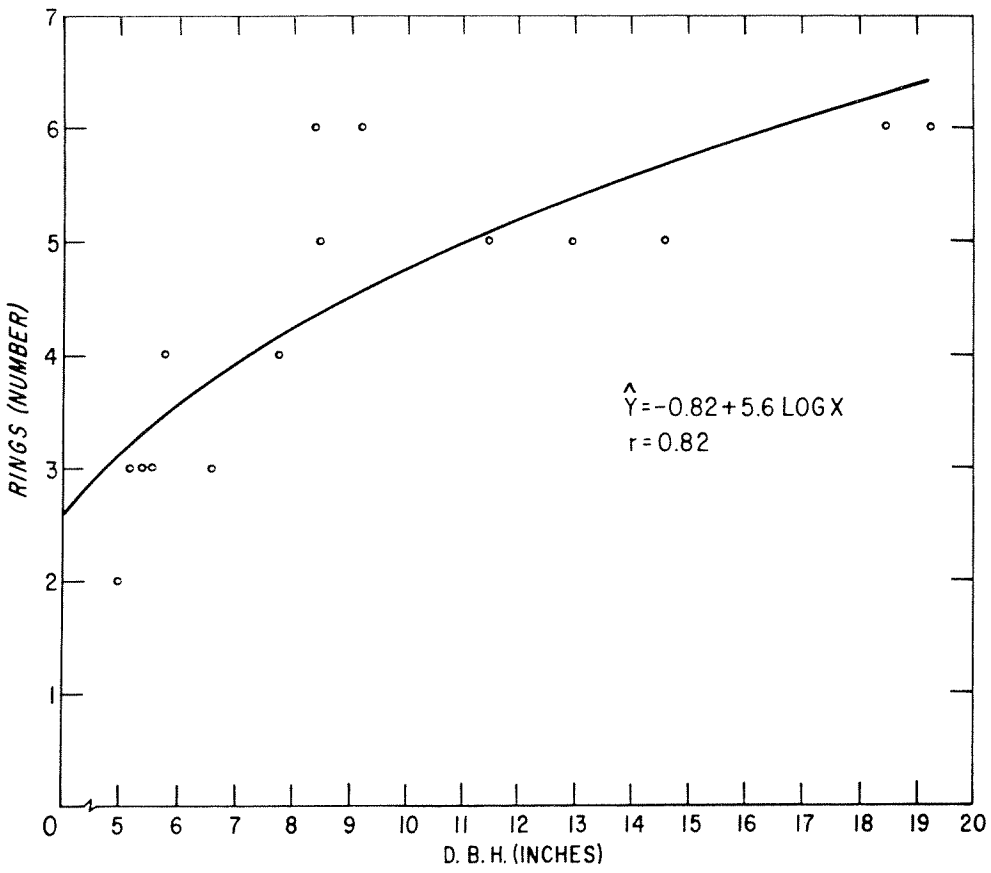

Figure 3.--Number of growth rings discolored by the balsam woolly aphid before the death of Fraser firs having different diameters at breast height.

CONCLUSIONS

Early detection of an infestation of the balsam woolly aphid would require examination of tree trunks at varying heights according to the total height of the tree. Small trees over 25 years old live fewer years after becoming infested by the aphid than do larger trees of the same age.

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